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AUTHOR Sinkavich, Frank J.
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ABSTRACT

The relationships between classroom performance and five possible predictor variables were studied. The ways in which these variables relate to performance in a classroom learning situation were examined, with the hypothesis that attributional style and motivation would be the best predictors of classroom performance. The variables were: (1) attributional style; (2) motivation; (3) self-testing ability; (4) information processing ability; and (5) use of metamemory. Subjects were 49 students from two graduate educational psychology courses who took two course examinations and one final examination. Students completed the Attributional Style Questionnaire and the Learning and Study Strategies Inventory and made confidence predictions for each item on each examination. Results of a stepwise regression analysis indicate that the use of metamemory, motivation, and attributional style comprised the best subset of predictors for examination performance. Use of metamemory and motivation were significantly correlated with performance. Implications for adult instruction and future research are discussed. Four tables provide data, and an 85-item list of references is included. (SLD)

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Metamemory, Study Strategies, and Attributional Style: Cognitive Processes in Classroom Learning

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Frank J. Sinkavich, Ph.D.
York College of Pennsylvania

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METAMEMORY, STUDY STRATEGIES, AND ATTRIBUTIONAL STYLE: COGNITIVE PROCESSES IN CLASSROOM LEARNING

Considerable research has been done in the areas of motivation, attribution, information processing, and metacognition. These areas have been studied in the fields of developmental psychology, personality, and cognitive psychology. Students enter the classroom with individual characteristics of learning and study strategies, attributional style, and various levels of prior knowledge. These cognitive and affective variables have long interested researchers. Educational psychologists have emphasized the function of learners' knowledge of specific tasks, as well as learners' cognitive processes and individual characteristics in classroom performance. Motivation, information processing ability, self-testing ability, use of metamemory, and attributional style are major components of the learning process, and are often considered in research focussed on how students learn.

There were two purposes of this study. To investigate the relationship between the variables of attributional style, motivation, self-testing ability, information processing ability, and the use of metamemory; and to describe how these variables relate to performance in a classroom learning situation. Students from two graduate educational psychology courses received two course examinations and one final examination. There were 32 students in a summer session class and 17 students in a winter term class who participated.

Students completed two inventories: the *Attributional Style Questionnaire*, and the *Learning and Study Strategies Inventory*, and made confidence predictions for each item on each examination. Results of a stepwise regression, $F(3,41,)=9.8$, $p<.001$, indicate that use of metamemory, motivation, and attributional style comprise the best "subset" of predictors for examination performance. Results also indicate that use of metamemory and motivation are significantly correlated with performance ($r=.52$, $p<.001$; $r=.42$, $p<.01$) respectively.

Results of the study indicate that learners' use of metamemory, motivation, and attributional style are the best predictors of examination performance. In addition, learners' use of metamemory and

motivation correlate significantly with examination performance. Learners with higher use of metamemory are better able to recall and apply course knowledge when compared to learners who do not make use of metamemory. Implications for adult instruction and future research questions are also discussed.

Introduction

Students enter the classroom with individual characteristics of learning and study strategies, attributional style, and various levels of prior knowledge. These cognitive and affective variables have long interested researchers (Dweck & Elliot, 1983; Dweck & Goetz, 1987; Dweck, 1989; McCombes & Whisler, 1989; McMahan, 1983; Metalsky, Abramson, Seligman, Semmel, & Peterson, 1982; Palmer & Goetz, 1988; Schmeck, 1988; Weinert & Kluwe, 1987; Weinstein, 1988a; Weinstein, Zimmerman, & Palmer, 1988; Wittrock, 1986). Educational psychologists have emphasized the function of learners' knowledge of specific tasks, as well as learners' cognitive processes and individual characteristics in classroom performance (i.e., testing and achievement). Motivation (one's ability or stimulus to succeed in an academic or learning situation; see Dweck, 1989), information-processing ability (the quality of one's use of cognitive processes to act on new and existing knowledge), self-testing ability (a study strategy: the degree to which one reviews and tests his/her level of understanding of knowledge, see Weinstein, 1988), the use of metamemory (the learner's ability to predict what they know and don't know; see Blair, 1987; Hart, 1965; Sinkavich, 1987), and attributional style (a learner's causal explanation of success and failure in an academic situation; see Metalsky, et al., 1982), are major components of the learning process, and are often considered in research focused on how students learn (Dweck & Elliot, 1983; Dweck & Goetz, 1987; Dweck, 1989; McCombes & Whisler, 1989; McMahan, 1983; Metalsky, et al., 1982; Palmer & Goetz, 1988; Schmeck, 1988; Weinert & Kluwe, 1987; Weinstein, 1988a; Weinstein, et al., 1988; Wittrock, 1986).

This study measured and investigated the relationship between motivation, information-processing ability, self-testing ability, use of metamemory, attributional style and how each relates to performance. This study also investigated the hypothesis that attributional style and motivation are the best predictors of classroom performance.

In past research, performance (i.e., achievement) was related to such variables as IQ and/or grade point average (GPA) in classroom learning. Class performance was

predicted by students' IQ scores or their grade point average (GPA) coming into the class. These variables are general in nature and do not take into account other individual differences (i.e., student characteristics). Newer models of classroom learning (e.g., cognitive information processing) however, have changed the way some educational psychologists view classroom performance (achievement) and the variables related to it.

In a current view of classroom learning (McCombs, 1988), the learner is responsible for attending to instruction, in addition to actively constructing the cognitive elaborations that result in *meaningful learning*. For example, this can be accomplished by paying attention to classroom instruction and actively (through the use of learning strategies such as elaboration, assimilation, and accommodation) creating or adding to an existing knowledge base in long-term memory. This study also investigated how metamemory (i.e., one's knowledge of the content of his or her long-term memory), in addition to cognitive (e.g., elaboration) and affective (e.g., attributional style) strategies relate to performance. In order for meaningful learning to occur, learners must be motivated and possess the skills and abilities to actively engage in appropriate metamemory, cognitive, and affective strategies (McCombs, 1988). For example, meaningful learning is facilitated by the use of elaboration and organizational strategies. These strategies help to bridge the gap between what a students knows and what he/she is trying to learn. The use of elaboration and organizational strategies place meaning on new information, and some educatiors see this as central to learners' performance in learning situations (Bransford, Vye, Adams, & Perfetto, 1989; Bransford, 1979, Bransford & Franks, 1976; Brown, Bransford, Ferrera, & Campione, 1983).

Motivation, attributional style, self-testing ability, information-processing ability, and use of metamemory are better understood when studied in an actual classroom learning situation. Metacognition (self-referent thought), existing knowledge base, cognitive processes (strategic knowledge), attributions, and motivation affect learning in different ways. A better understanding of motivation, attribution, information-processing

ability, and accurate use of metamemory may come from studying these variables under actual learning conditions. This study focused on classroom learning and performance in a graduate course in educational psychology.

Statement of the problem

This study examined the relationships between the following five variables and classroom performance in order to determine which of these variables is the best predictor of students' performance.

Motivation

Weinstein, et al. (1988), define motivation as learners' attitude and degree of stimulus to succeed in and accept responsibility for their performance in an academic setting. For example, this is reflected in the day-to-day behaviors students exhibit related to school tasks. Such behaviors include reading textbooks, being ready for class, and finishing assignments on time.

Information-processing

Meaningful learning is intensified by the use of elaboration and organization strategies. Such strategies supplement the building of links between what learners already know and what they are trying to learn. Using what one already knows (i.e., prior knowledge, attitudes, study strategies and experience) is critical to success in classroom learning. The way knowledge is organized, not just the sheer amount of knowledge, makes a difference in students' performance (Weinstein, et al., 1988). In other words, information-processing ability is how well one cognitively acts on new and existing knowledge. Information-processing ability directly affects one's learning and performance.

Self-testing

Reviewing and testing one's level of understanding are important for knowledge acquisition (i.e., learning) and comprehension monitoring (e.g., metacognition). These

strategies support and contribute to learning and performance. Self-testing ability also contributes to knowledge consolidation and integration (i.e., accommodation and assimilation) across topics. For example, the use of mental reviews, reviewing class notes, and thinking of possible test questions are all methods for checking one's understanding of new and existing knowledge (Weinstein, et al., 1988). The degree to which students use self-testing ability is an important factor in classroom learning and performance.

Use of metamemory

The use of metamemory is defined as a learner's ability to predict what they know and do not know. The ability to use metamemory has been implicated in research studies (Blair, 1987; Lachman & Lachman, 1978; Maki & Berry, 1984; Shaughnessy, 1979; Sinkavich, 1987; Sinkavich, Shermis, & Block, 1986).

Evidence exists to show that students can make fairly accurate judgements about what they know and do not know and what they can and cannot remember (Hart, 1965, 1966, 1967). Both theory and data suggest that students can make fairly accurate judgements about the correctness of their responses on multiple choice examinations. The ability to make an accurate judgement is the use of metamemory.

Attributional style

The causal explanations for success and failure in an academic situation constitute a learner's attributional style. In other words, attributions are viewed as efforts to make sense of, or to interpret, the causes of events; these perceived causes are presumed to decide subsequent affective responses, expectancies, and behaviors (Wittrock, 1986). For example, a student may attribute success to his or her own effort. On the other hand, a student may attribute his or her own success to luck. Effort is perceived to have nothing to do with success for such a student.

Different instruments will be used to assess these variables. Motivation, information-processing ability, and self-testing ability was assessed by the *Learning and*

Study Strategies Inventory, (Weinstein, Zimmerman, and Palmer, 1988; see operational definitions of terms). Attributional style was assessed using the *Attributional Style Questionnaire* (Peterson, Semmel, von Bayer, Abramson, & Seligman, 1982; see operational definitions of terms). Finally, use of metamemory was assessed on each classroom examination by use of a prediction scale (Blair, 1987; see operational definitions of terms).

The present study focuses on the following research questions:

1. What are the relationships among the variables of motivation, information-processing ability, self-testing ability, the use of metamemory, attributional style and actual classroom examination performance?

2. Considering the variables: 1) attributional style, 2) motivation, 3) information processing ability, 4) self-testing ability, and 5) the use of metamemory, is there one best predictor or set of predictors of students' actual classroom examination performance?

Hypotheses

1. Attributional style, motivation, information-processing ability, self-testing ability and use of metamemory are related to actual classroom examination performance.

2. Attributional style and motivation are the best predictors of actual classroom performance.

Definition of terms

Motivation

Although general motivational level is important, so is a student's motivation to perform the specific tasks related to achievement. The degree to which students accept

responsibility for studying and their academic performance is reflected in the day-to-day behaviors they exhibit related to school and academic tasks (Weinstein, 1987). For example, these behaviors include reading a textbook, preparing for class, completing assignments on time, and being disciplined in studying even when a topic is not particularly interesting (Weinstein, 1987). Students' scores on the *Learning and Study Strategies Inventory* (LASSI) subscale of motivation measure the degree to which students accept the responsibility for performing the specific functions and tasks related to academic success. Motivation is related to attributional style in that a "motivated" student will have a positive attributional style. That is, a student will attribute success or failure to his/her own efforts and accept responsibility for the learning outcome. The motivation score is expressed as a percentile rank ranging from zero to one hundred.

Information-processing

Quality of information-processing (how students process knowledge) is defined as students' scores on the information-processing subscale of the LASSI. The information-processing subscale assesses how well students can create abstract and verbal elaborations and organizations to promote understanding and memory recall. These elaborations and organizations are important parts of the learning process. The Information-processing score is expressed as a percentile rank ranging from zero to one hundred.

Self-testing

Reviewing and testing one's level of understanding (a metacognitive process) are important for knowledge acquisition and comprehension monitoring (also a metacognitive process). These strategies support and contribute to meaningful learning and effective performance (Weinstein, 1987). Without these strategies, learning may be incomplete or errors will exist and go undetected by the learner. Reviewing and self-testing also enhance knowledge consolidation (organization) and integration across domains (Weinstein, 1987). Metacognitive processes such as mental reviews, going over class notes and the course text,

thinking of potential questions to guide further study or getting ready for an examination (self-testing) are important methods for checking understanding, consolidating new knowledge, integrating related information (new knowledge and prior knowledge) and deciding if additional study is required (Weinstein, 1987). Self-testing is assessed by the LASSI subscale "Self-testing." The self-testing score is expressed as a percentile rank ranging from zero to one hundred.

Use of metamemory

Accurate use of metamemory is defined as students' confidence in item correctness on a multiple choice examination (see Blair, 1987; Sinkavich, 1987). Confidence in item correctness (metamemory accuracy) was assessed by a four-point scale with ratings of "Wild Guess," "Educated Guess," "Probably Right," and "Definitely Right."

Attributional style

Attributional style is defined as either positive or negative. Attributional style was assessed using the *Attributional Style Questionnaire*. The Attributional Style Questionnaire (ASQ) is a self-report inventory of a student's tendency to select certain causal explanations for good and bad events (i.e., success or failure in an academic situation).

The ASQ focuses on two types of attributional style: positive and negative. A positive attributional style is defined as a style students use where they tend to attribute success or failure to internal causal explanations (e.g., I did not study hard enough), an attribution to their own efforts for failure in an academic situation. In other words, students take responsibility for their poor performance. On the other hand, a negative attributional style is defined as a style students use where they tend to attribute success or failure to external causal explanations (e.g., It is not my fault, it was too noisy to study), an attribution to events beyond their control for success or failure in an academic situation. In other words, students do not take responsibility for their poor performance and attribute

success to luck. The primary catalyst for the development of the ASQ was Abramson, Seligman, and Teasdale's (1978) reformulation of the learned helplessness model of depression (Seligman, 1975).

Literature review

Learner characteristics

Learner characteristics influence what adults learn, and affect the level of performance on learning tasks. For example, attitudes, interests, health related factors, motivation, attribution, prior knowledge, and cognitive strategies all influence adult learning. In addition, prior knowledge of course material can influence course performance. Processes that act upon knowledge (retrieval processes, judgement processes, and generative processes) also influence adult learning.

Adult learners display monumental differences in the factual knowledge, repertory of relevant skills, and person, task, and strategy variables they bring to a learning situation. These individual learner characteristics influence performance during instruction and learning. Three types of learner characteristics are of interest to educational psychology in the study of adult learning: 1) prior knowledge base, abilities, and strategies that directly relate to the training task; 2) metacognition/metamemory (self-knowledge of ability, memory and relevant skills); and 3) noncognitive variables (e.g., motivation).

Information that students enter into short-term memory while studying will be transferred to long-term memory and hopefully will be recalled when they take examinations. The student's belief that he or she needs to study, and the decisions about when and how to study, as well as estimates of students' readiness to recall information when they take an examination, are metacognitive skills (Duell, 1986). Related to metacognitive skills is the concept of metacognitive knowledge.

Flavell (1979) defines metacognitive knowledge as that component of an adult's stored world knowledge that has to do with individuals as cognitive beings, and with their divergent cognitive tasks, goals, actions, and experiences. This includes knowledge about human thought processes in general and knowledge about one's strengths and limitations as a thinker. For example, a student might believe that he/she learns information better if it is stated in his or her words, rather than if the information is repeated verbatim from the

study materials. Or a student might believe that he or she can learn a list of definitions efficiently if the words can be grouped together according to categories (Flavell, 1979).

Brown (1981) distinguishes between two types of metacognition: (a) knowledge about cognition and (b) regulation of cognition. The first, knowledge about cognition, includes knowledge about one's own cognitive resources, and how compatible the demands of learning situations are with one's own resources. Knowledge about cognition is stable over time. That is, if a student believes today that he or she can learn better by re-stating information in his or her own words, it is likely that this student will believe the same tomorrow. In addition, knowledge about cognition can be stated by the learner, may not be accurate, and is late developing (Brown, 1981).

The second type of metacognition is regulation of cognition. This type of cognition is made up of self-regulatory mechanisms that are used by an active learner during an ongoing attempt to solve a problem. These activities are thought to be (a) somewhat stable (i.e., the learner may use them on some occasions but not on others), (b) rarely stateable (i.e., learners know how to do many things they cannot describe in words), and (c) somewhat independent of the learner's age. According to Brown (1981), some examples of regulatory metacognitive activities are: "*planning* one's next move, *checking* the outcome of any strategies one might use, *monitoring* the effectiveness of any attempted actions, *testing, revising, and evaluating* one's strategies for learning" (pp. 21-22).

These two types of metacognition can be distinguished hypothetically. However, the concept of metacognition is probably more readily understood when the two types are considered in concert (Brown, 1981).

While metacognitive knowledge refers to knowledge about human cognition, knowledge about and regulation of memory is called metamemory. One example of metamemory would be if Sheila believes that a good way to find a "mislaid" item is to retrace cognitively her steps until she recalls the last place she had the item, since it involves what Sheila knows about how to use her memory.

In a review of metamemory literature Schneider, (1985) found a substantial relationship between memory performance and one's knowledge of memory processes. Flavell (1971) defines metamemory as knowledge of one's own memory processes. The focus of its attention is on self-awareness and self-control in learning situations. Thus, the relationship between metamemory and study skills (i.e., learning and study strategies) is established.

Cognitive information processing

The cognitive information processing model (Andre and Phye, 1986) is based on a structure proposed by Atkinson and Schiffrin (1968) and Craik & Lockhart (1972). The cognitive information processing model (CIP) states that learning and behavior result from an interaction of the environment and the previous experience and knowledge of the learner. The CIP model characterizes the mind as a processing structure consisting of components for processing information, and procedures for using its basic components (e.g., storing, retrieving, transforming). Thus a general model of cognitive information processing has five basic components: Sensory registers; input; short-term memory; long-term memory (knowledge); an executive routine (metacognition/metamemory); and output buffers (a process called automatization). Adult learning and thinking consists of dynamic processing of information by the components of this system.

Interaction of storing, retrieving, and transforming processes are central to the information processing view (Andre & Phye, 1986). These processes originated in the traditional cognitive view of psychology. There are four processes that influence knowledge in the cognitive information processing model: Retrieval, executive, generative, and prior knowledge. These processes affect the use of prior knowledge and the integration of new knowledge into long-term memory. Therefore, these processes relate to learning.

Retrieval processes

Retrieval processes are strategies that allow one to remember information stored in long-term memory. When retrieval processes fail, forgetting follows. Retrieval processes, therefore, directly relate to academic performance. Retrieval refers to transferring knowledge from long-term memory into short-term memory. The CIP model predicts that differences in processing will lead to differences in quality of learning outcomes. The outcome of learning depends on material presented, the existing knowledge base (prior knowledge) with which it is assimilated, how knowledge is encoded into long-term memory, and if transfer of knowledge from long-term memory into short-term memory takes place (Craik and Lockhart, 1972; Mayer, 1984; 1987).

Executive processes

Evaluative, regulatory, and planning (judgment) processes are the executive component of the memory system. Andre & Phye, (1986) conceptualize the executive processes similar to the way an operating system's program is conceptualized in a computer system. The operating system in a computer (mainframe and microcomputers) is a program that works in the background while some other program(s) are being used. In a computer the operating system keeps track of what each program is doing, what it needs to know, and controls various memory allocitations for operation based on a pattern of priorities programmed into the system. In the human executive, the pattern of priorities is determined by our motivations and goals (Andre & Phye, 1986).

Generative processes

Generative processes (those used to produce knowledge), such as learning and study strategies, construct knowledge. These strategies differ from evaluative processes in that evaluative processes "evaluate" or act upon knowledge. The importance of generative processes like metacognition (which also can function as an evaluative process), metamemory, encoding, and retrieval have been documented in the literature (Andre &

Phye,1986; Brown, 1981; Mayer, 1984; 1987; Weinstein, 1987). Learning and study strategies are specific techniques and general plans that facilitate the achievement of one or more instructional objectives. These include strategies and skills students need to manage and monitor their learning in a variety of contexts (Weinstein, et al., 1988). There is a similarity between the description of metacognition and what some call study skills (Brown, 1978). The strategies and skills students need to manage and monitor their learning in a variety or contexts are partially a function of prior knowledge.

Prior knowledge

Prior knowledge is the knowledge (declarative and procedural) that a learner already has in memory when he or she enters a classroom. Intellectual skills, cognitive strategies, verbal information, and attitude are all forms of prior knowledge or learning. New learning is based on the use of prior knowledge to understand new situations, and changing prior knowledge structures to deal with new situations (Andre and Phye, 1986). Learning requires the use of effective strategies (Bransford, et al., 1989). Learning strategies do little good if one lacks prior knowledge to comprehend new information (Bransford et al., 1989). The ability to make inferences depends on the activation of prior knowledge and comprehension depends on the activation of general world knowledge (Bransford et al., 1989).

Previous research suggests that differences in previously acquired knowledge affects learning, memory, and problem-solving (e.g., Chase & Simon, 1973; deGroot, 1965). Recent research also indicates that the ability to use learning strategies depends on the prior knowledge base of the learner (e.g., Cermak & Craik, 1979; Craik & Lockhart, 1972; Hyde & Jenkens, 1969). Clearly, the ability to process knowledge at the semantic level presupposes a prior knowledge base that is adequite (Bransford et al., 1989).

Learning and the use of prior knowledge directly relates to one's executive control processes. A learner's prior procedural knowledge of a criterion task, or factual

(declarative) knowledge about the type of problem represented in the criterion task, is a learner characteristic that has been frequently associated with performance (Willis, 1985). For example, research by Hoyer & Plude (1980) suggests that the degree of learners' prior knowledge with target tasks may be related to utilization of automatic, as opposed to effortful, processes. In other words, a learner's particular strategy may be automatized (processed without conscious thought) and not a conscious, effortful, problem-solving process. Likewise, prior knowledge has been related to the depth of semantic processing (Craik and Lockheart, 1972) and the complexity of the organizational strategies (encoding scheme) that the learner employs. Related to the four processes of the CIP model that influence knowledge are person, task, and strategy variables.

Person, task, and strategy variables

Person variables include lasting general characteristics that change little over time. One example would be a learner's ability to predict how many items he or she can recall correctly information from long-term memory (Duell, 1986). Some types of information are more difficult to learn and later retrieve than are others. Knowledge of the relative difficulty of different types of information are part of a learner's metamemory (Duell, 1986). Such information could include how the make-up of individual items affects a learner's retrievability (recall). In addition, metamemory can contain knowledge about how the relationships between items affect the retrievability (recall) of information.

Learners may develop knowledge of strategies (rehearsal, elaboration) for storing information in and retrieving it from memory. Flavell and Wellman (1977) point out that in "real life," learners enounter "open-book" as opposed to "closed-book" problems. In other words, learners are free to access external resources (books, other learner's memories) besides their internal resource, long-term memory. Academic settings are prime situations where a premium is placed on accessing internalized resources.

It is unlikely that learners consider the person, task, and strategy variables in isolation; It is more likely that learners consider these variables collectively and adjust their learning activities to account for their combined influence in a given situation (Flavell and Wellman, 1977). Adjustment of learning activities is related to self-directed learning.

The role of a self-directed learner requires at least a minimal sense of one's academic goals (e.g., creating and maintaining motivation, focusing attention, exerting cognitive effort, diligence). These are, to some extent, dependent on the student's goal-directed orientation (Weinstein, 1988). To be an autonomous learner (i.e., self-regulated) requires identifying goals, analyzing, clarifying, and adjusting them, and determining when adjustments are required (Weinstein, 1988).

A useful goal contains five key elements. A useful goal is: (a) specific, (b) measurable, (c) challenging, (d) realistic, and (e) one with a stated completion date. The realistic element is one of the most difficult of the five key elements (Schunk & Gaa, 1981; Shaw, Saari, & Latham, 1981). To make a determination of realism the learner has to make a judgement. Making a judgement requires the learner to have an adequate existing knowledge base, and have strategies for assessing and manipulating knowledge and strategies effectively. Such judgements require *metacognitive awareness* (the degree to which students reflect about themselves as learners), *metacognitive knowledge* (specific information students have about themselves as learners also their knowledge about learning tasks, strategies, and specific learning tactics), and *executive control* (capacity to plan, implement, monitor, evaluate, and modify a cognitive course of action) (Brown, Armbruster, & Baker, 1986; Flavell, 1979).

It is necessary for students to have knowledge of cognitive strategies (knowing how to plan, knowing various learning strategies such as elaboration, note taking, rehearsal, summarizing) so that they can guide their learning and thinking. Strategy knowledge includes the learner's ability to use different methods, and knowing when these methods

are appropriate to use (Weinstein, 1988). Knowledge of learning strategies and self-directed learning is related to motivation.

Motivation

Noncognitive variables (e.g., motivation, self-regulation) are a part of the learning process. What and how much is learned by any learner is a function of that learner's motivation and ability to engage in appropriate self-directed, self-regulated, and autonomous information processing activities, (i.e., learning) (McCombs and Whisler, 1989).

Academic performance, self-concept, self-efficacy, intrinsic motivation, competence motivation, anxiety, and attribution all influence learning. These influences are individual characteristics of the learner. The amount of influence each characteristic has varies among adult learners. Motivational influences can affect performance either positively or negatively.

Ideally, students are motivated by a need to develop understanding or to solve problems. Brophy (1986) refers to this as "motivation to learn." Achievement motivation involves striving toward a particular class of goals, those involving competence. There are two subclasses of goals: (a) learning goals, and (b) performance goals (Dweck, 1989). Learning goals are those in which students attempt to increase their competence, to understand/master something new. Performance goals are those in which students attempt either to document their competence, gain favorable judgements of their competence, or avoid negative judgements of their competence (Dweck & Elliot, 1983).

Adaptive/facilitating motivational patterns are those that promote the establishment, maintenance and attainment of personally challenging and valued achievement goals (Dweck, 1989). Maladaptive goal patterns have been associated with failure to establish reasonable, valued goals, failure to maintain effective effort toward those goals, or failure to attain valued goals that are potentially within a learner's reach.

Learning and performance goals may be associated with aggressive achievement activity. Learning and performance goals tend to be differentially associated with adaptive and maladaptive motivational patterns (Dweck, 1989). That is, learning goals predict the pursuit and mastery of challenging tasks more reliably than performance goals.

Individual differences partially account for how one usually approaches and responds to various situations (motivational patterns); these combine with situational cues (task variables) to determine a learner's expectancies and values. The result affects the learning outcome (performance) (Dweck, 1989). Some situations appear to elicit momentary adaptive (positive) or maladaptive (depressive) patterns in most students (Dweck, 1989). For example, a situation can evoke high or low goal value, high or low expectancy, and high or low interest.

Individual differences in motivational patterns are not viewed as the presence or absence of adaptive or maladaptive motivational patterns (Dweck, 1989). Individual differences are thought of in terms of the probability that such patterns will be actualized across academic situations. Adaptive and maladaptive motivational patterns can have (a) many biases, (b) take a variety of forms, and (c) occur with respect to different goals (Dweck, 1989).

An individual is motivated in an achievement context to reach a particular goal. Examples include gaining social recognition, pleasing one's parents or spouse, outperforming classmates, and achieving extrinsic rewards such as good grades (Stipek, 1988).

Although, Stipek (1988) states that learning can occur with external reinforcement (good grades) she argues that students learn best in academic situations in which they perceive themselves to be participating in learning for their *intrinsic* reasons (interest in the task). Stipek's assumption is that learners engage in learning tasks partly for the purpose of developing competence and experiencing a positive feeling of accomplishment (efficacy) that can be associated with learning. Competence can be defined by the learning

task or by the social environment in which learning occurs. Extrinsic reward is not required in all cases for learning to occur (Stipek, 1988).

Motivational theorists emphasize the importance of learner's perception of causality, rather than some objective index of causality. Individuals are intrinsically motivated when they perceive themselves as the cause of their behavior (DeCharms, 1976, 1984; Deci, 1975) . Intrinsic motivation influences a learner's self-perception.

Learner's perception of self and learning strategies

Definitions of cognitive strategies differ, but the view that strategies are learner-initiated actions is found across definitions (Palmer and Goetz, 1988). Because learners' initiative or choice plays a critical role in strategy definitions, this suggests a significant influence of motivation in the study of strategy use.

Students' perceptions of their achievement outcomes (performance) may affect strategy use. The student who perceives himself or herself as incompetent may be reluctant to attempt the use of any strategy (Palmer & Goetz, 1988). In addition, the match among students' perceptions of their personal attributes and strategy attributes may subsequently influence their decision as to whether to use a strategy. Ultimately, a learner's perceived capability of using learning strategies for obtaining a desired outcome also may affect the decision for strategy use (Kennedy & Miller, 1976).

Current attempts to include motivational variables (e.g., attribution, self-concept) in models of cognitive functioning influenced Palmer & Goetz (1988) to develop a model of strategy use. The core elements in this model are students' perceptions of task attributes, strategy attributes, and their ability as learners.

Students who are confronted with academic tasks in instructional settings bring with them varying amounts of prior knowledge, different histories of cognitive functioning and various academic outcomes. Student characteristics (individual differences) in turn influence students' perceptions of themselves, the instructional task, and the cognitive

learning strategies that they are familiar with and may invoke (Palmer & Goetz, 1988). Weiner (1972, 1974, 1979) suggests that students' perceptions of achievement events include judgments (e.g., attributions) concerning their ability, effort, and task difficulty. Palmer & Goetz (1988) have proposed that learners use different learning strategies based on characteristics of the task, and the level of the learners' effort, intelligence, and prior knowledge required for effective use. Borkowski, Johnston, & Reid, (1987) have implicated the interactions between motivational and metamemory beliefs in explaining why some learners, despite intellectual functioning, use strategies on transfer tasks where others do not.

Adult learners and strategy use

Strategy use in adult populations is influenced by the learner's existing knowledge structure, strategy knowledge, and individual motivational factors (Palmer & Goetz, 1988). Academically capable learners appear to have more knowledge regarding, and make more use of, learning and study strategies than do academically incapable peers. Effective readers and studiers are more flexible and adaptive in their use of strategies and more aware of the variables that influence the appropriateness of domain specific strategies. Learning ability monitors the degree to which students regulate the comprehension process. Less-able learners are more prone to emotional responses and therefore affective factors interfere more with their learning process relative to able learners. In other words, when faced with comprehension difficulties, less proficient learners are inclined to react affectively, rather than effectively.

There is a dynamic interaction between personality and cognition. Furthermore, personality may be best viewed as an interaction of intrinsic factors (motivation, attribution) and prior learning that results in individual differences in cognitions about oneself and one's environment (Palmer & Goetz, 1988; Schmeck, 1988). Both affective and

cognitive components appear to influence students' performance on academic tasks (Palmer & Goetz, 1988).

Attribution

Attributional beliefs, (beliefs about the causes of success and failure) have been the focus of current motivation research. For example, beliefs about the extent to which individuals are responsible for and control their cognitive assets can be especially important determinants of how they approach cognitively demanding tasks (e.g., examination taking) and, in particular, the enthusiasm with which they attempt to improve their list of available cognitive skills.

Clearly beliefs can either encourage productive behavior or inhibit it. Some researchers have stressed the interdependence among cognitive, personality, and motivational variables on academic performance (Borkowski, et al., 1987). They suggest that metacognitive knowledge influences attitudes and learning, as well as attributional beliefs about the relationships between success, failure, and effort. The cause and effect relationship between attributional beliefs and metacognitive knowledge is an interactive one. That is, not only do dysfunctional attributional beliefs ("no amount of effort on my part can help") inhibit the acquisition of metacognitive knowledge, failure to acquire that knowledge reinforces the dysfunctional beliefs. Conversely, functional attributional beliefs ("My effort makes a difference") help the acquisition of metacognitive knowledge; the acquisition of metacognitive knowledge reinforces the positive attributional beliefs (Borkowski, et al., 1987).

According to Wittrock (1986), many emprical studies support the hypothesis that students will be highly motivated to continue to learn when they attribute success or failure to their effort, or the lack of it, rather than to forces over which they have little or no control (ability, luck, or other people). Learners' attributions about the causes of their success and failure influence their interest, persistence, and motivation to learn. Success in

school enhances motivation primarily when students attribute the results to their effort, as opposed to other people or factors outside their control (Wittrock, 1986).

One approach to understanding students' performance in an achievement-related setting is the attributional theory proposed by Weiner (1974, 1976). Drawing from Rotter's (1966) locus of control research, Weiner's model provides a synthesis of cognitive and motivational constructs. Simply stated, attributions are viewed as efforts to make sense of, or to interpret, the causes of events; these perceived causes are presumed to decide subsequent affective responses, expectancies, and behaviors (Wittrock, 1986).

Research suggests that there are four primary perceived causes of student achievement outcomes: ability, effort, task difficulty, and luck. The four perceived causes represent three dimensions: stability, locus of control, and controllability (Weiner, 1974; 1976). Ability and task difficulty are stable, while effort and luck are unstable. The locus of control dimension runs from external to internal; while ability and effort are viewed as internal, task difficulty and luck are considered external (Wittrock, 1986). Individuals' attributions for their performance influence their expectancy for future performance, persistence, affective reactions, and task choice (Weiner, 1972, 1974). Frieze (1976) notes that the major antecedent cues for attributions include performance outcome, history of performance, and performance of others. In other words, your explanation for your performance on a test is influenced by how well you did on the test, how well you have done on other tests in the past, and how well others did in comparison to you.

McMahan (1973), and Weiner, Nirenburg, & Goldstein (1976), noted a relationship between stable attributions and individuals' expectancy for future performance. Among individuals who attribute an outcome to stable causes, those who are successful tend to expect continued success, while those who fail expect continued failure. Therefore, the learner who attributes failure on a test to lack of ability is unlikely to expect better results on future tests.

Results from attribution studies support the view that attributions moderate the expectancy and performance changes that result from success and failure (Dweck, 1989). One of the most consistent findings in the attribution literature is that attributing failure to a lack of ability predicts declining expectancies, decreased persistence, and impaired performance in the face of difficulty. On the other hand, attributing failure to insufficient effort, faulty strategy, or bad luck predicts maintenance of high expectancies, high persistence, and good performance under failure. Such attributions often predict heightened effort and improved performance during failure (the use of more efficient strategies) and following failure (increased speed and accuracy compared to pre-failure performance (Dewck & Goetz, 1978).

Attributional Style Questionnaire

The *Attributional Style Questionnaire* (ASQ) (Peterson, Semmel, vonBayer, Abramson, & Seligman, 1982) is a self-report measure of patterns of "explanatory style", which is the tendency to select certain causal explanations for good and bad events (success or failure in an academic situation). The primary catalyst for the development of the ASQ was Abramson, Seligman, and Teasdale's (1978) reformulation of the learned helplessness model of depression (Seligman, 1975). This reformulation states that when faced with an uncontrollable bad event, a person will wonder why it occurred. Seligman's model suggests that how people answer the question "Why" will help determine their adaptation to the event (Weinert and Kluwe, 1987). Abramson, et al., (1978) contend that there are three dimensions related to a person's causal attributions: locus of one's causal explanation; stability of the causal explanation; and, globality of the causal explanation. Each dimension relates to a particular aspect of adaptation to an uncontrollable event.

The first dimension in Seligman's model is the locus of one's causal explanation. In other words, did an event occur because of something about me (an internal attribution) or something about the situation (an external attribution)? The second dimension of

Seligman's model is the stability of a causal explanation. In other words, did this event occur because of something that will persist (a stable attribution) or something that is transient (an unstable attribution)? The final dimension of Seligman's model is the globality of the situation. That is, will the cause of an event influence many aspects of life (i.e., a global explanation) or influence only the currently experienced event? With this framework in mind, Seligman and his colleagues developed the ASQ. The ASQ is designed to measure an attributional style as opposed to giving an explanation for a particular event.

The ASQ has been employed favorably with college students (Peterson, et al., 1982). For example, in a study of college students and their reactions to a low grade on a midterm examination, students who habitually explained bad events (low midterm grade) in terms of internal, stable, and global factors were more likely to feel depressed after learning that they received a low grade than were students who tend to explain bad events in terms of external, unstable, and specific factors (Metalsky, et al., 1982). The practical significance of this result is the possibility of identifying students at risk for depressive reaction to bad academic events based on explanatory style.

Attribution and metamemory

According to Borkowski & Krause (1985), students who attribute their success on individual items to effort, and their failures to lack of effort, were higher in their knowledge of metamemory than those students who attributed their outcomes to uncontrollable factors (ability or task characteristics). Students who held established beliefs about the role of effort in producing success on academic tasks were higher in metamemory and showed greater strategy transfer than students who tended to attribute performance outcomes to non-controllable factors (Borkowski & Krause, 1985). According to attribution theory, beliefs associated with one's knowledge of general memory play a unique role in orienting and sustaining student attention, especially on difficult strategy generalization tasks (Borkowski, Milstead, & Hale, 1988).

In the literature on attribution theory, students' performance and the processes involved in setting criteria are viewed as part of a larger framework of motivation, based on causal attributions concerning successes and failures. Two dimensions of attributions have been identified: 1) internal/external; and 2) stable/unstable. Individuals may attribute success or failure to one of these four pairwise combinations. For example, success may be attributed to ability (internal/stable), effort (internal/unstable), task difficulty (external/stable), or luck (external/unstable).

When developmental issues are considered, parallels between causal attributions and metamemory emerge. For example, processes investigated by attribution researchers are closely related to those in metamemory research (Wellman, 1983). In addition, attribution research is itself a representation of the influence of metacognition on performance. Flavell and Wellman (1977) note that individuals' performance may be influenced by their perceived characteristics, task characteristics, strategy use, and the interactions among the three components. Fabricius and Hagan (1983) demonstrated that attributions about strategy performance are predictive of subsequent strategy use. Similarly, Kurtz and Borkowski (1984) reported that students who show higher levels of metamemory tended to attribute their successful learning to effort expanded during the study period.

Borkowski et al., (1987) suggest that attributive and metacognitive processes are bidirectional. They argue that the acquisition of metacognitive knowledge is influenced by causal attributions regarding past performance. In addition, attributions appear to play an important role in future application of metacognitive knowledge in transfer situations.

Students are active participants in the learning process. Therefore, they must call upon their metacognitive skills to benefit from instruction. Whereas many learning situations are structured to be sensitive to the growing abilities of students, learners are not always guided in a gradual manner. Successful learners are those who can deal with both gradual and abrupt transitions in instruction (Borkowski, et al., 1988).

Adult metamemory

Beginning with the research on the feeling-of-knowing phenomenon (Hart, 1965), knowledge and beliefs about memory contents, abilities, and strategies have received considerable attention. Under the feeling-of-knowing paradigm, the person perceives that the target information (i.e., that which is to be recalled) is stored, and that further retrieval efforts may result in recalling the elusive information from memory (Hart, 1965). The situation in which the target information is on the tip-of-the-tongue is often accompanied with an increased motivation to remember, and with good success rates (Hart, 1965). Under these specific conditions, the metamemory/memory relationship is respectably high (i.e., better than chance).

One important assumption about metamemory relationships is that memory and metamemory performance are closely related (Brown, 1978; Cavanaugh & Perlmutter, 1982; Flavell, 1981; Wellman, 1978). A more specific assumption is that metamemory beliefs, like self-knowledge and the feeling-of-knowing, are antecedents of strategic memory behavior and subsequent memory performance (Dixon and Hertzog, 1988).

Use of metamemory

Evidence suggests that students can make accurate judgements about what they know and do not know, and what they can and cannot remember. The initial work was done by Hart (1965). Accurate use of metamemory was investigated by Sinkavich (1987) and Blair (1987). Results suggest that good students are more accurate than poor students in their ability to predict their performance on classroom examinations. According to Blair (1987), good students are better at judging whether an answer is correct or not once they feel that they are definitely right, when compared to poor students who are less accurate. Good and poor students are equally adept at stating "I know that I don't know that" when an item is judged (i.e., predicted) to be incorrect.

Summary

The study of the cognitive and affective processes of the learner continues to be emphasized in developmental and cognitive psychology. There is an increased acknowledgment of and interest in the role of the individual's characteristics or differences in learning and performance. Developmental and cognitive psychologists have emphasized the role of the learner's knowledge of specific tasks, and his or her cognitive processes and characteristics. Personality and developmental psychologists have investigated the role of motivational and attributional factors as antecedents of the learner's attributions, expectations, achievement-related behavior, performance, and cognitive outcome (Palmer & Goetz, 1988).

Both cognitive and noncognitive (i.e., affective) components influence learners' performance on academic tasks. To understand the role of the learner in academic situations, one must consider how self-referent thought (metacognition), knowledge of task and topic (a prior knowledge base), strategic knowledge (cognitive processes) and beliefs (attributions) combine and interact in a learning situation.

Research indicates that individual differences in cognitive and affective processes among learners are an important part of the learning process. A learner's attributional style, existing knowledge, learning strategies, metacognitive knowledge, and metamemory influence learning outcomes (i.e., performance). The current study further investigates the nature of these relationships.

Method

The method used in this study was descriptive/correlational in nature. The dependent variable was classroom performance as measured by a multiple choice examination. Predictor variables were: 1) motivation, 2) information processing ability, 3) self-testing ability, 4) use of metamemory, and 5) attributional style.

Before intervening with an experimental manipulation of variables a descriptive/correlational study is the logical place to start in order to clarify the relationships of the variables in question. For this reason, the descriptive/correlational method was the method chosen for this study.

Sample

The subjects in this study were students from three classes in the psychological foundations of education taught at a large University. Two classes met in the 8-week Summer term 1989, one in the Winter term 1990. There were two different instructors. One for the two Summer term classes and One for the Winter term class. Topics of instruction were learning and development with regard to learning, language, communication, socialization, cognitive development, cognitive learning theories, learner motivation, learner strategies, and adult learning. The instructional method used was lecture.

Characteristics of the participants in the research are as follows. For the Summer term 1989 there were 21 females (67%) and 11 males (33%) with a mean age of 31.9 years. For the Winter term 1990 there were 10 females (75%) and 7 males (25%) with a mean age of 29.1 years. Four students (one female and three male) dropped out of the study in the Winter-90 class. The total sample therefore included 30 females (69%) and 15 (31%) males for a total of 45 students with a mean age of 30.8 years. The classes were combined for statistical analysis. International students were not included in the above numbers or used in the study for the following reasons:

1. Difficulty with the English language.
2. The vast difference in culture and academic background.

3. The possible effects of diverse culture and academic background on attribution, use of metamemory, and learning and study strategies.

Materials

The type of classroom examination used was multiple choice. Each examination consisted of approximately 50% knowledge and 50% application questions. Each question was followed by a "Likert type" rating scale consisting of four anchor points: "Wild Guess," "Educated Guess," "Probably Right," and "Definitely Right."

Knowledge items were used to assess declarative knowledge (i.e., knowledge that). For example, "In single subject designs, each subject's performance is compared with his/her performance during a ... ." Application items were chosen to assess procedural knowledge (i.e., knowledge how). For example, "If a person sneezes after coming close to a realistic-looking artificial flower, you can be pretty sure that he or she ... ." Test items covered lecture material, textbook chapters, and assigned readings. Items were part of an item data-base created by the course instructors.

Examination item characteristics

There were three examinations given to three classes for a total of nine examinations. The examinations were given at the following intervals in the Summer 1989 classes: Examination one was given 14 days after the start of the term, examination two was given 14 days after examination one, and the final (third) examination was given 10 days after examination two. For the Winter 1990 class the first examination was given five weeks after the start of the term, examination two was given four weeks after examination one, and the final (third) examination was given four weeks after examination two. Only the final (third) examination was used in the data analysis. The first two examinations introduced the students to the idea of prediction and permitted practice using the scale before the final examination. Examination performance was a percentage score.

Test items were the same for the Summer 1989 classes (i.e., both received the same examination). The Winter 1990 class test items, although similar in content, were different.

Rating task on examination

Each examination had a "Likert-type" rating scale following the possible choices for each item. The rating scale had four categories: Wild Guess, Educated Guess, Probably Right, Definitely Right. Students were instructed to place an "X" on the scale indicating how they felt about their answer to each particular item. Previous use of this scale (Blair, 1987; Sinkavich, 1987) indicated that students can predict their answers with better than chance accuracy.

Each rating scale had the following values assigned to each choice: Wild Guess = 1, Educated Guess = 2, Probably Right = 3, and Definitely Right = 4. A mean prediction rating was calculated for each student (the sum of the scale values for all items on the examination divided by the number of items on the exam). To assess the accuracy of learner predictions, items that were judged to be a Wild Guess were incorrect and were scored one point as a incorrect hit. Items judged to be Definitely Right were correct and were scored one point as a correct hit.

The metamemory score was derived as follows: The number of correct hits and incorrect hits were added and divided by the total number of items on the final examination (exam 3).

For example:

Number of items on the final examination = 50
Number of correct hits = 20
Number of incorrect hits = 5

Total = 25

Metamemory score = 25/50 or 50%

Attributional Style Questionnaire

The Attributional Style Questionnaire (ASQ) is a self-report measure of patterns of "explanatory style" which is the tendency to select certain causal explanations for good and bad events (e.g., success or failure in an academic situation). The Attributional Style Questionnaire (© 1984 Martin E.P. Seligman; used with the author's permission) is composed of 12 hypothetical events, 6 good and 6 bad. Each event has 4 questions that are always in the same order. The first question asks for one major cause of the event. This question is not used in the scoring procedure but is necessary in order for the test-taker to answer the next three questions on whether the cause of the event is external or internal, stable or unstable, global or specific.

Three scores were calculated for the ASQ: Composite Positive (CoPos), Composite Negative (CoNeg), and Composite Positive minus Composite Negative (CPCN). Scores are arrived at by averaging across dimensions (external or internal, stable or unstable, global or specific) and across events (good and bad) for composite scores. Composite scores range from 3 to 21 for CoPos and CoNeg and from -18 to +18 for CPCN. Higher CoPos or CPCN scores indicate less "learned helplessness" and a positive attributional style. Similarly, a low CoNeg score indicates low "learned helplessness and a positive attributional style (Seligman, 1984). The reliability of the ASQ is .75 for CoPos and .72 for CoNeg as estimated by Cronbach's (1951) alpha. Test-retest correlations for CoPos and CoNeg are .70 and .64 respectively (Peterson and Seligman, 1987).

Learning and Study Strategies Inventory

The electronic version of this inventory (E-LASSI) was used in the study. The E-LASSI subscales (10) include the following: attitude, motivation, time management, anxiety, concentration, information processing, self-testing, knowledge of test-taking strategies, main ideas, and study aids. Only the LASSI subscales of motivation, information processing, and self-testing were used in the study. The reliability for the E-

LASSI subscales of motivation, information-processing, and self-testing are reported as .87, .88, and .64 respectively as measured by Cronbach's (1951) alpha. Test-retest correlation for the whole inventory is .88 (Weinstein, Zimmermann, and Palmer, 1988).

The inventory-taker is presented with a series of instruction screens that explain the choice of responses to the statements (i.e., items) from the E-LASSI. Following the instruction screens, the student is given a chance to review them again or start the E-LASSI. The E-LASSI is composed of 77 statements. For Example, "I worry that I will flunk out of school." Each statement may be responded to by one of the following phrases. The following selection of responses stays on the screen at all times during the inventory:

A) Not at all typical of me
B) Not very typical of me
C) Somewhat typical of me
D) Fairly typical of me
E) Very typical of me

After pressing one of the five keys (A, B, C, D, E) in response to the item, the next E-LASSI item is presented. Pressing any key other than A,B,C,D, or E is not accepted. A valid response is requested (Invalid Choice, please re-enter), while the choices at the top of the screen remain unchanged. After the 77th statement the data are processed and saved. At this point the student has finished the E-LASSI and turns off the computer.

Procedure

Students from three graduate basic areas of education classes were asked to participate in a research study. At the first class meeting the researcher and the course instructor explained the risks, benefits and need for such research to be conducted. All students were given two copies of a consent to participate form (see Appendix C) by the investigator. The form was explained and all students were asked to sign both copies and return one to the investigator. Students were to return the forms in one week if they decided

to participate in the research study. Students were told that their participation was voluntary and if they chose to not participate this would in no way affect their course grade. This procedure was the same for all three classes in the study.

Those students who returned consent forms the following week, N=26 for the Summer session and N=23 for the Winter term, were given the Attributional Style Questionnaire (ASQ). The ASQ was explained by the investigator. Students were told that the ASQ is a way to assess attributional styles. In addition, participants were told that they had one week in which to complete the questionnaire. The investigator collected all of the ASQ's at the next class meeting . This procedure was the same for all three classes in the study.

When students returned their ASQ's to the investigator they were asked to sign-up for a time most convenient for them to take the *Learning and Study Strategies Inventory* (E-LASSI). The E-LASSI was administered on an AT&T 6300 microcomputer. The investigator set up the computer hardware and software for each student. Students were instructed to enter an ID number (assigned by the investigator) for confidentiality. The investigator stayed with each student through the introduction and directions that are part of the E-LASSI. The E-LASSI takes from 15 to 25 minutes to complete. When a student finished the E-LASSI he/she immediately got a printed profile of his/her responses. This profile contained a description of each of the ten scales with each of the three-letter codes used to identify each scale. In addition, the report contained a graph that displays the student's responses to the E-LASSI. The graph displayed percentile ranks from 1 to 99 in 5 percent increments. The student's score was marked with an X on each of the ten columns, one for each sub-scale. A sample LASSI profile can be found in Appendix D. The profile was explained to each student by the investigator at the conclusion of the E-LASSI.

When all participants completed both inventories (ASQ, E-LASSI) they were given a report of their results. This report contained the student's name in addition to the scores that the student received on the ASQ (3) and the E-LASSI (10). These reports were

generated from the raw data (i.e., scores) of both inventories. These data were entered into a database, (FoxBase Plus Mac™), stored and used to generate individualized student reports for each participant.

Examinations

On each examination, students were asked to select their multiple choice answer and then to rate their confidence in that answer by marking a Likert type scale with 4 anchor points noted as "Wild Guess," "Educated Guess," "Probably Right," and "Definitely Right." On each examination, the students were instructed to assess their confidence in each answer as correctly as they could. Students were given the following instructions for each examination:

> "Each question is followed by a scale. Indicate how *Correct You Feel* your answer is by *Placing* an X on the scale. Thank You."

Students were told that development of this ability (to assess their confidence) should help in their examination taking.

On all three examinations, students were given microcomputer generated test profiles of their prediction ability as examination feedback. The feedback for each examination included: 1) A histogram and table of all students' predictions across item confidence scales (i.e., frequency distribution), 2) a table of the frequency distribution of predictions for correct items, and 3) a table of the frequency distribution of predictions for incorrect items. Feedback reports were printed in an Apple LaserWriter™ Plus and individualized for each participant. These reports were generated on an Apple Macintosh™ SE/30 microcomputer using Microsoft File II™ as a database and Statview II ™ for statistical analysis. Raw data from the examinations (e.g., confidence scale values) were first entered and stored in the Microsoft File II™ database. Stored data were then transferred to Statview II™ for statistical analysis and generation of feedback for students. The feedback was given to students at the next regular class meeting after the first

and second examinations. Feedback for the final (third) examination was mailed to students since the examination was given the last day of class.

The histogram and table of all students' predictions across item confidence scales (i.e., frequency distribution) was explained as follows: Students were told that the histogram indicated their predictions for all items (correct and incorrect) and how they were distributed across the four categories "Wild Guess," "Educated Guess," " Probably Right," and "Definitely Right." The table that accompanied the histogram listed the histogram categories, number of responses in each, and the percent of the total for each category for all items. A table of the frequency distribution of predictions for correct items listed the scale categories, number of responses in each, and the percent total in each category. Finally, a table of the frequency distribution of predictions for incorrect items listed the scale categories, number of responses in each, and the percent total in each category. A scale mode was also reported (where one existed) for all three tables. Students were told that the mode was the response they gave most often. Students were instructed to compare their examination feedback (e.g., percent predicted correct) to that of their classmates, to determine how relatively accurate they were.

Results and Discussion

Results

The intent of this study was to examine the relationship between the following five variables and classroom performance: 1) motivation, 2) information processing ability, 3) self-testing ability, 4) use of metamemory, and 5) attributional style, and to determine which of these five variables is the best predictor(s) of students' classroom performance.

Method

Multiple regression was used in the study for data analysis. The criterion variable in the analysis was classroom performance (exam 3 scores). There were five predictor variables in the analysis: 1) motivation, 2) information processing ability, 3) self-testing ability, 4) use of metamemory, and 5) attributional style.

Sample

For the Summer session, 1989, there were 20 females (67%) and 11 males (33%) who volunteered to participate in the study. For the Winter term, 1990, there were 10 females (75%) and 4 males (25%) who volunteered to participate in the study. The total sample therefore, included 30 females (69%) with a mean age of 29.8 years and 15 (31%) males with a mean age of 32.7 years for a total of 45 students with a mean age of 30.8 years. The classes were combined for statistical analysis.

Descriptive statistics

Summary data for both inventories (LASSI; ASQ) and the classroom examination used in the study can be found in Table 1.

Table 1

Descriptive Statistics of Variables

Inventory	Variable	Min	Max	M	SD
ASQ	CPCN	-4.84	9	3.48	2.65
LASSI	SFT	5	95	66.44	25.62
	INP	20	99	69.42	22.60
	MOT	5	99	65.13	22.97
Prediction Score	Metamemory Use	8.9	82.9	40.5	21.68
Exam 3	Performance	48.9	97.5	78.9	10.6

N = 45

Attributional style (CPCN) was assessed by the *Attributional Style Questionnaire* (ASQ). The values for attributional style found in Table 1 are raw scores with a possible range from -18 to 18. Self-testing ability (SFT), information-processing ability (INP), and motivation (MOT) were assessed with the *Learning and Study Strategies Inventory* (LASSI). Scores for self-testing ability, information processing ability, and motivation found in Table 1 are percentile ranks. Performance was defined as students' final examination scores. These scores are expressed as a percent in Table 1. Metamemory use was measured from the prediction scales on the final examination; these scores are expressed as a percent in Table 1. It can be seen from Table 1 that the LASSI subscale scores (SFT, INP, and MOT) varied widely in the sample. The use of metamemory also varied widely in the sample.

Examination performance

The final examination was used to collect data regarding metamemory use and performance in both classes. Table 2 summarizes final examination statistics for both the Summer session and Winter term classes in which data were collected. Percent of correct responses was used because the two examinations varied slightly in total number of items (see Table 2).

Table 2

Final Examination Summary

Class	No. of Items	Mean Score	Median Score	SD	Reliability (KR-20)	Low Score	High Score
Summer-89	45	33.06 (73.4%)	34.50 (76.7%)	5.17	0.76	21 (46.7%)	41 (91.1%)
Winter-90	41	33.93 (82.7%)	34.64 (84.5%)	3.49	0.63	25 (60.9%)	40 (97.6%)

Correlational analysis

The first research question asked: What are the relationships among the variables of motivation, information-processing ability, self-testing ability, use of metamemory, attributional style, and actual classroom examination performance?

Table 3 presents the relationships among the variables. As indicated the relationships for 6 of the 15 pairs were significant. The LASSI subscales of self-testing ability (SFT), information processing ability (INP), and motivation (MOT) correlated moderately with each other (r=.55, r=.50, r=.54 respectively). Two predictor variables correlated significantly with the criterion variable (i.e., performance): Motivation (MOT) and use of metamemory (r = .42 and r = .52 respectively) (see Table 3).

Table 3

Correlation Matrix of Cognitive and Affective Variables and Performance Scores

Variable	CPCN	SFT	INP	MOT	MMU	PER
SFT	.16					
INP	.02	.55**				
MOT	-.00	.50**	.54**			
Metamemory Use (MMU)	.24	.45*	.19	.29		
Performance (PER)	-.14	.24	.15	.42*	.52**	

N = 45

*$p < .01$

**$p < .001$

Regression analysis

The second research question asked: Considering the variables of attributional style, motivation, information-processing ability, self-testing ability, and the use of metamemory, is there one best predictor or set of predictors of students' actual classroom examination performance? To answer this question a stepwise multiple regression was used. The criterion variable in the regression was performance (final examination score). The possible predictor variables were attributional style (CPCN), motivation (MOT), information processing ability (INP), self-testing ability (SFT), and use of metamemory (prediction scores).

The analysis resulted in three variables being entered into the regression in the following order: Use of metamemory, motivation (MOT), and attributional style (CPCN). The remaining two variables, self-testing ability (SFT) and information processing ability (INP) did not contribute significantly to the regression given that the first three variables

had entered. Therefore, they were not entered into the "best" subset. The stepwise regression model was significant, $F(3, 41) = 9.797$, $p < .001$ (see Table 4). The three variables account for 41.8% of the variance.

Table 4

Summary of Stepwise Regression Analysis

Source	df	MS	F	R^2
Regression	3	.068	9.8*	.42
Residual	41	.007		

*$p < .001$

Discussion

The first research question was: What are the relationships among the variables of motivation, information processing ability, self-testing ability, use of metamemory, attributional style, and actual classroom examination performance? Pearson product moment correlation results indicated that 6 of the 15 correlations were significant. As Table 3 indicates, the LASSI subscales of self-testing ability (SFT), information processing ability (INP), and motivation (MOT) were significantly correlated with each other (r=.55, r=.54, and r=.50 respectively). This indicated that these three variables partially overlapped. An intercorrelation matrix for the E-LASSI sub-scales was not available. These variables can be viewed as cognitive processes that act upon knowledge as discussed in the literature on cognitive information processing (see Andre and Phye, 1986).

The three LASSI subscales (MOT, INP, and SFT) demonstrate a wide range in the sample. Wide range of scale use is consistent with results found by C.E.Weinstein (personal communication, June 11, 1989).

Use of metamemory also has a wide range of scores (see Table 3). These results were expected and were consistent with the research reported by Blair (1987) and Sinkavich (1987). Such results indicate that students within a class vary widely in their use of metamemory. Current literature states that metamemory use in the adult populations is influenced by learners' existing knowledge, cognitive strategies, and affective variables. In adult populations the amount of existing knowledge, use of cognitive strategies, and the impact of affective variables varies widely. Blair (1987) and Sinkavich (1987) found significant differences in metamemory use between "good" and "poor" students. They concluded that not all learners make efficient use of metamemory.

It should be noted that self-testing ability (SFT), as shown in Table 3, does not correlate with performance. This result was unexpected. It may be that because self-testing ability is significantly correlated with motivation and information-processing (see Table 3), and because motivation is significantly correlated with performance, the relationship between self-testing and performance is not as clear as it might be.

Self-testing ability (SFT) correlated significantly with use of metamemory ($r=.45$, $p < .01$). This result was consistent with the current literature on learning and study strategies and metamemory/metacognition. Self-testing is a metacognitive strategy (Weinstein, 1987) and metamemory is, in part, one's knowledge of cognitive strategies. The relationship between self-testing and use of metamemory was expected.

The correlation between motivation (MOT) and performance (see Table 3) was significant ($r = .42$, $p < 01$). This finding supports the current literature on student motivation and achievement in academic situations. Motivation has a significant influence on the use of study (i.e., cognitive) strategies (Palmer and Goetz, 1988). The amount of influence motivation has on performance varies among adult learners. Motivation is part of the learning process. What, and how much, is learned by any student is a function of that student's motivation and ability to engage in appropriate information processing activities (McCombs and Whisler, 1989). The relationship between motivation and performance was

expected. This result indicated that learners' motivation has an influence on the classroom learning process. Motivated students in the sample demonstrated higher performance.

The correlation between use of metamemory and performance (see Table 3) was also significant ($r = .52$, $p<.001$). This result was expected and is consistent with research reported by Blair (1987) and Sinkavich (1987) on graduate student metamemory. Sinkavich (1987) reported correlations between metamemory and performance on two final examinations with a range of r=.35 to .65, $p<.01$. According to Blair (1987), "Good students are better at judging whether an answer is correct or not once they feel that they are definitely right, when compared to poor students who are less accurate." Good and poor students are equally adept at stating "I know that I don't know that" when an item is judged (i.e., predicted) to be incorrect.

The second research question was: Considering the variables of attributional style, motivation, information processing ability, self-testing ability, and the use of metamemory, is there one best predictor or set of predictors of students' actual classroom examination performance? Results of the regression analysis (see Table 4) indicated that there was a best predictor "subset" (use of metamemory, motivation, and attributional style).The regression analysis was significant, $F(3,41) = 9.8$, $p < .001$. Two variables (self-testing ability and information processing ability) did not contribute significantly to the model and, therefore, were not part of the best "subset."

These results indicated use of metamemory, motivation, and attributional style had a significant impact on classroom performance. These variables accounted for 42 percent of the variance in the sample. Prior research in educational psychology (discussed in the literature review) indicated that individual differences in cognitive and affective variables among learners are an important part of the learning process. A learner's use of metamemory, motivation, and attributional style influences learning outcomes. That is, use of these three cognitive and affective processes increases performance.

Conclusions and Implications

Conclusion

Much research has been conducted in the areas of motivation, attribution, information-processing, and metacognition/metamemory. These areas have been studied in the fields of developmental psychology, personality, and cognitive psychology. The intent of this study was to investigate relationships between the variables of attributional style, motivation, self-testing ability, information-processing ability, and the use of metamemory in an actual classroom learning situation. The study of these relationships is an essential part of understanding the learning processes used by adult students in the acquisition and application of course knowledge.

Both cognitive and noncognitive (i.e., affective) components influence learners' performance on academic tasks. To understand the role of learners in academic situations, one must consider how self-referent thought (metacognition), knowledge of task and topic (a prior knowledge base), strategic knowledge (cognitive processes) and beliefs (attributions) combine and interact in an actual classroom learning situation.

Prior research in educational psychology indicates that individual differences in cognitive and affective processes among learners are an important part of the learning process. A learner's attributional style, existing knowledge base, use of learning and study strategies, metacognitive knowledge, and use of metamemory influence learning outcomes (i.e., performance). This study investigated the nature of these relationships.

The hypotheses under investigation in this study were the following:

1. Attributional style, motivation, information-processing ability, self-testing ability and use of metamemory are related to actual classroom examination performance; and
2. Attributional style and motivation are the best predictors of actual classroom performance.

The first hypothesis was partially supported. Results indicated that use of metamemory and motivation correlated moderately with classroom performance (see Table 3). In the sample, students with higher final examination scores (performance) also had higher scores for use of metamemory. It might be said that students who frequently invoked metamemory were better able to recall and apply course knowledge when compared to students who did not invoke metamemory. These results supported previous research in the area of metamemory use (see Blair, 1987; Sinkavich, 1987).

Previous research has demonstrated that motivation is related to academic performance. The current study suggests a similar relationship. Results indicated a significant correlation between motivation and performance (see Table 3). Students who score high on the LASSI subscale of motivation (MOT) tend to have higher final examination scores (performance). No causal relationship is implied here, only a positive, moderate relationship. Clearly one has to be "motivated" to perform well, but based on the data, it can not be said that motivation causes higher performance scores, or that high performance scores indicate a high level of motivation in students.

The second hypothesis states that attributional style and motivation are the best predictors of actual classroom performance. Results of the study indicated that the best "subset" of predictors of performance in the classroom learning situation investigated are: Use of metamemory, motivation, and attributional style. Although this hypothesis was stated in language suitable for making causal predictions, causality cannot be inferred from the data set. Two predictor variables in the study were not part of the model: 1) information processing ability and 2) self-testing ability.

Implications

The study of metamemory processes in graduate students and adult learners is an essential part of understanding the learning processes used by learners in the acquisition and application of course knowledge. Optimal use of previously acquired course knowledge is, in part, a function of learners' accurate use of metamemory.

Except for gerontological work and life-span developmental studies (Lachman & Lachman, 1980), and later studies on metamemory use (Blair, 1987; Sinkavich, 1987), most studies of what we know about our own knowledge have focussed on the metamemory capabilities of children or exceptional populations (e.g., special education populations). Studies have either used experimentally learned materials, or to a lesser degree they have been concerned with knowledge recalled and used in a wide variety of settings (i.e., world knowledge). This study was concerned with knowledge of educational psychology that is acquired in a course. Such knowledge in principle ought to enhance our expertise in the education profession.

A central assumption of higher education is that knowing particular disciplines enhances expertise in a profession. Knowledge of course information is by itself insufficient; students must be able to use it. A significant component of being able to use knowledge optimally is accurate use of metamemory. This permits, for example, direct access of information one knows rather than just using valuable time to infer facts that one should be able to access directly.

The findings of this study indicated that, for the adult graduate students in the sample, use of metamemory, motivation, and attributional style were the best predictors of classroom examination performance. In addition, students' use of metamemory and motivation correlate significantly with examination performance.

Recommendations for instruction

Results of this study suggest that when designing instruction for adult learners, one should take into account such individual differences as attributional style, motivation, and use of metamemory. Research has demonstrated that while most students gradually develop adequate metacognitive skills, others do not. Metacognitive strategies can be taught to students who do not develop them on their own, and the results can be marked improvements in performance (Slavin, 1988).

With some effort and planning, an instructor can make logically organized and relevant (meaningful) presentations. Getting students to use cognitive strategies is not always easy. As adults develop and gain more experience with increasingly complex academic tasks, they acquire a greater awareness of metamemory, metacognitive knowledge and their relationship to classroom learning and performance. Instructors can facilitate this process by guiding learners toward maximum use and development of their metacognitive knowledge and use of metamemory.

Most adults are inefficient learners (see Brown, Campione, and Day, 1981; Covington, 1985). Their attempts infrequently go beyond rote rehearsal, simple organizational schemes and surface encoding of information. In most classroom situations students are rarely explicitly instructed in improving their cognitive abilities. The amount of independent learning expected of students increases constantly from elementary school through college and beyond. It may be that instructors rely too much on subject matter at the expense of teaching *how* to learn.

A number of different methods have been proposed to implement the training of these individual differences (e.g., use of metamemory) at the post-secondary level. One method, embedded instruction, concentrates on incorporating learning strategies training into existing educational materials. Examples of this are print materials and workbooks. In this method, cognitive learning and study strategies are made part of the printed material to which the learner is exposed. Embedded instruction focuses on incorporating cognitive strategies into existing educational materials. Embedded instruction allows the instructor to concentrate on course material during lectures and class presentations. This type of material is most effective when instruction is given to large numbers of students, there is a high teacher turnover rate, or too few qualified teachers are available (Weinstein, 1988b). Another approach, metacurriculum, is used to teach learning strategies along with regular classroom course material in existing classes (Weinstein, 1988b). This second approach is one that, if implemented, may be most beneficial to adult learners.

Using Weinstein's approach, implementation of a metacurriculum for adult learning would require an instructor to integrate the instruction of affective and cognitive strategies into both planned and unplanned activities that occur during a class. For example, when a textbook is assigned, the instructor could pause and discuss the various strategies learners could implement to preview and use a textbook. Another example would be using an analogy to help explain a difficult concept such as a microcomputer operating system. This is also a good time for the instructor to discuss elaboration, its role in learning, and how learners might use this method on their own. By explicating a strategy and the relevant learning goal, providing explanations to learners on how to use a strategy, providing feedback, and from time to time combining various strategies to help learners create an effective overall approach to studying, instructors would be implementing a metacurriculum.

Results of this study indicated that use of metamemory, motivation, and attributional style were related to performance. Previous research (Dixon & Hultsch, 1983a; 1983b) indicates that older adults do not use as effective organization strategies (i.e., metamemory) as younger adults. It is possible that adult learners' performance could be improved by using a metacurriculum approach.

The degree to which learners accept responsibility for performing the specific functions and tasks related to academic success (i.e., motivation) is related to, and a predictor of performance in this study. This motivation is reflected by learners' day-to-day behaviors that are related to school and academic tasks. Examples include reading a textbook, completing assignments on time, preparing for class, and having disciplined study habits. An instructor who deemphasizes grades and relative rankings, but expresses the expectation that all students in the class can learn, is likely to help students see that their chances of success depend, at least somewhat, on their effort (an internal but alterable attribution that lets students anticipate success in the future if they do their best). These behaviors, too, might be influenced by the use of a metacurriculum, which in turn should

increase learners' performance. Finally, attributional style (a learner's tendency to select certain causal explanations for good and bad events) might be influenced through the instruction of the cognitive strategies discussed above.

Recommendations for future research

More research is required before there will be a detailed understanding of relationships between use of metamemory, motivation, and attributional style. Work on metacognition/metamemory will be especially informative if researchers study self-regulated cognition in task situations of varying ecological validity, complexity, and familiarity. Such task situations will force consideration of several factors that may affect metacognition/metamemory, including cognitive and affective factors that may differ in adult learners.

Clearly, more research is needed in the area of classroom performance and its relationship to cognitive and affective variables. This study has shown that, in part, future research might focus on the following areas:

Does incorporating cognitive and affective strategy instruction into course content significantly improve learners' performance? That is, is the incorporation of an instructional method (such as metacurriculum) worth the instructors' time in regard to learner performance? Will such an instructional method, in and of itself, increase learner performance significantly to justify its implementation, or will it need to be modified in some way to address individual differences not discussed in this study (e.g., socioeconomic status).

Another area for future research to focus might address the following questions: When cognitive and affective strategies are taught, are they domain specific? In other words, would the learner use the new strategies in a different course? Can instruction be in the form of "general" cognitive and affective strategies or must such strategies be domain specific in order to produce increased performance?

A final area of focus might address the following: Can the relationships between use of metamemory, motivation, attributional style, and performance be mapped more clearly? Can the methodology be implemented to give researchers and educators a better idea of how these relationships might be analogous?

'Both cognitive a id noncognitive components influence learners' performance on academic tasks. In understanding the role of learners in academic situations, one must consider how metacognition, knowledge of task and topic, cognitive processes, and attributions combine and interact in an actual classroom learning situation and how these variables influence the learning of course knowledge. Results of the study indicate that learners' use of metamemory, motivation, and attributional style are the best predictors of examination performance. In addition, learners' use of metamemory and motivation correlate significantly with examination performance. Learners with higher use of metamemory are better able to recall and apply course knowledge when compared to learners who do not make use of metamemory. Using the metacurriculum model to impliment instruction is a step toward incorporating both cognitive and affective strategies resulting in more meaningful learning t and increased performance.

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